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## Preliminary studies of seed dormancy in *Datura stramonium*

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Seed germination studies of *Datura stramonium* suggest that the endosperm and to a lesser extent the testa impose dormancy on the embryos by restricting the growth of the radicle. Mechanical removal of the testa alone does not improve germination. However, removal of the endosperm in addition to the testa gives improved germination, as does the soaking of seeds with the testa removed in solutions of gibberellic acid or benzyladenine.

Kiemingstudies met saad van *Datura stramonium* dui daarop dat die endosperm en tot 'n mindere mate die saadhuid verantwoordelik is vir die rustoestand van embrio's deur die groei van die kiemwortel te beperk. Meganiese verwydering van beide die saadhuid en die endosperm bevorder kieming. Soortgelyke resultate is verkry as die saadhuid verwyder is en as die saad sonder saadhuid in oplossings van gibberelliensuur of bensieladenien geweek is.

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The thorn apple (*Datura stramonium* L.) (Solanaceae) is a troublesome weed in many parts of the world, including South Africa (Parsons 1973). Hagood *et al.* (1981) rate *D. stramonium* as the third most common broadleaved weed in field crops and fifth most difficult broadleaved weed to control. Seeds of *D. stramonium* have been shown to remain dormant in the soil for many years (Parsons 1973). Germination studies done to date have shown that 35°C is the optimum temperature for germination (Vegis 1963). Kinzel (1926) reported that seed germination was indifferent to light or dark. In view of the paucity of information on the germination of seed of this common weed, an investigation was undertaken of some of the factors influencing germination and the factors possibly contributing to the dormant condition of the seed.

Fruits were collected from a disturbed area on the outskirts of Pietermaritzburg. Seeds were removed from each capsule and stored dry in brown paper bags in the dark at 20 ± 2°C until required for experimentation. In a preliminary trial seeds were incubated on moist filter paper in the dark at constant temperatures of 5°, 10°, 20°, 25°, 30°, 35° and 38°C. No germination occurred. Seeds were then scarified by removing a small portion of the testa, endothelium and endosperm from each seed in the region of the radicle (Figure 1) and then incubated on moist filter paper at the temperatures mentioned above. Seeds germinated at all temperatures with the maximum being at 35°C. This latter temperature was the same as the optimum temperature reported by Vegis (1963) and was used in all subsequent trials. Samples of 100 seeds were then scarified by removing a small portion of the testa, endothelium

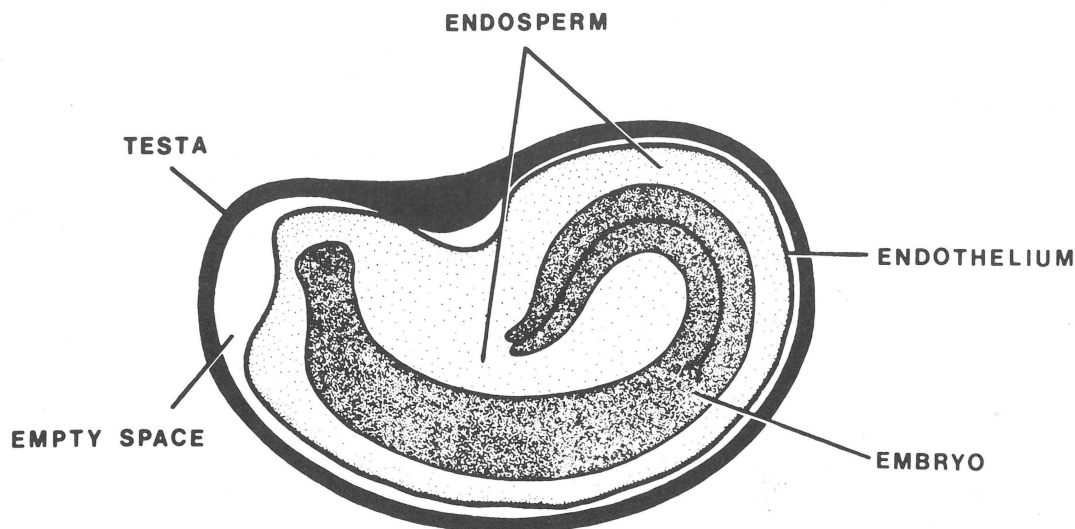


Figure 1 Longitudinal section through the seed of *Datura stramonium* showing the different layers that surround the embryo ( $\times 32$ ).

**Table 1** Germination of scarified seeds of *D. stramonium* incubated at  $35^{\circ}\text{C}$  in either the dark or under continuous white light. Figures are mean percentages ( $\pm \text{SE}$ ) from two trials of 50 seeds each, after 6 and 12 h incubation

Treatment	Germination %	
	Incubation time	
	6 h	12 h
Continuous light	$28 \pm 2,5$	$52 \pm 7,3$
Dark	$82 \pm 4,2$	$96 \pm 2,4$

and endosperm in the region of the radicle and incubated at  $35^{\circ}\text{C}$  either under continuous white light ( $11 \text{ Wm}^{-2}$ ) or in the dark. The results in Table 1 show that a higher percentage germination was obtained for the scarified seeds incubated in the dark. Consequently all further germination tests were carried out in the dark. These results contradict those of Kinzel (1926) who found that germination in *D. stramonium* was indifferent to light and dark. In order to determine whether seeds were dormant as a result of the testa being impermeable to water, the water uptake of intact seeds, scarified seeds and seeds with the testa removed, was monitored over a period of 120 h. The percentage increase in mass was taken as an indication of water uptake by the seeds. The results in Figure 2 show that the seeds in all three treatments imbibed water. The testa was thus permeable to water and the absence of germination in samples of intact seeds was apparently not due to a lack of water reaching the embryos.

In a series of tests to show the effect of site of scarification on germination it was found that scarification at the radicle end, at the chalazal end and on the side of the seed midway between the radicle and chalazal ends opposite the hilum, were all equally effective in giving a high percentage germination within 12 h of incubation. In a further experiment the testa alone was removed from the seed, care being taken not to damage the endothelium and the endosperm. After 15 days of incubation at  $35^{\circ}\text{C}$  no germination had occurred. These results suggested that the testa itself was not responsible for imposing dormancy, but that the endothelium and/or endosperm might be preventing radicle emergence. In a further

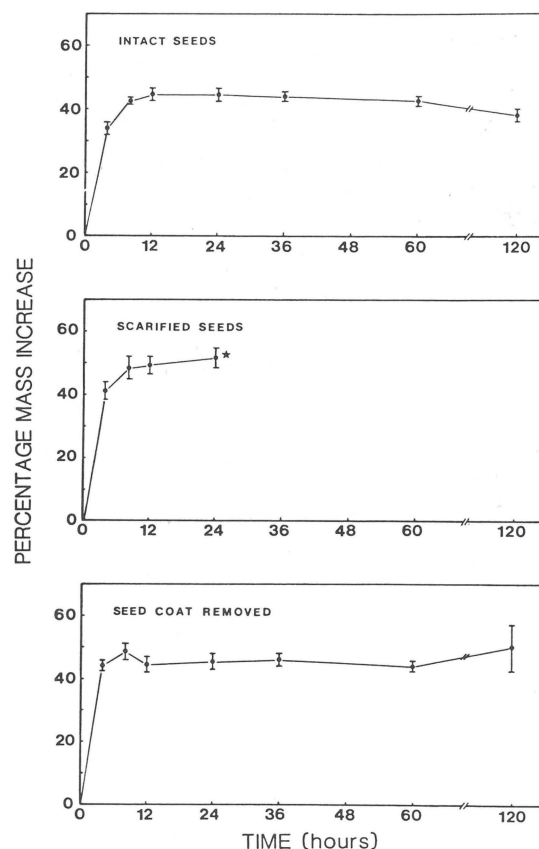


Figure 2 Rate of imbibition of seeds of *Datura stramonium* when intact, when scarified, and with the seed coat (testa) removed. The asterisk\* indicates when germination occurred and subsequent mass determinations were not carried out. Vertical bars represent standard errors.

experiment, the testa of each seed was removed and the endothelium scraped away carefully with a sharp blade. Care was taken not to damage the endosperm. Seeds were incubated at  $35^{\circ}\text{C}$  for 10 days. No germination occurred during this period suggesting that the endosperm rather than the endothelium was responsible for preventing radicle emergence. The endosperm is hard and 'plastic'-like and transmission electronmicrographs (unpublished data) show that the endosperm cells are packed with lipid bodies and protein bodies and have very little residual cytoplasm. Ikuma & Thimann (1963) have shown that the endosperm of lettuce seeds imposes

**Table 2** Germination of seeds of *D. stramonium* incubated in the dark at 35°C after the removal of part of the testa, endothelium and endosperm. Figures are mean percentages ( $\pm SE$ ) of two trials of 50 seeds each, after 6 h and 12 h incubation

Treatment	Germination %	
	Incubation time	
	6 h	12 h
Control (unscarified)	0	0
Testa, endothelium and endosperm removed	80 $\pm$ 2,5	100

**Table 3** Germination of seeds of *D. stramonium* with and without the testa intact following soaking in gibberellic acid or benzyladenine for 24 h at 35°C. Figures are mean percentages ( $\pm SE$ ) of two trials of 50 seeds each, after 15 days incubation

Treatment	Germination %	
	Testa intact	Testa removed
Water (control)	0	0
Gibberellic acid	0	80 $\pm$ 3,2
Benzyladenine	0	85 $\pm$ 10,5

dormancy by acting as a mechanical barrier to embryo growth. In seeds of *D. stramonium* it is possible that the endosperm cells restrict the growth of the radicle, as once the endosperm was chipped away and the seeds incubated under moist conditions, the radicle emerged within 6–12 h (Table 2).

In a further experiment, intact seeds and seeds with the testa removed, but with endothelium and endosperm intact, were soaked either in water (control), gibberellic acid (10 mol dm<sup>-3</sup>) or benzyladenine (10 mol dm<sup>-3</sup>) for 24 h in the dark at 35°C. After soaking, the intact seeds and the seeds with testa

removed were incubated on moist filter paper in the dark at 35°C for 15 days. Neither the intact seeds nor the seeds with the testa removed germinated following soaking in water. However, seeds with the testa removed germinated following treatment with gibberellic acid or benzyladenine (Table 3). The results show that hormone treatment enabled the radicle to penetrate the endosperm. This could occur as a result of the hormones enabling the radicle to develop sufficient thrust to penetrate the hard endosperm. Alternatively, the hormones may have stimulated an enzymic softening of the endosperm enabling the radicle to penetrate.

The testa is permeable to water (Figure 2) and assuming that the hormone solution was able to reach the embryo, the radicle was still not able to develop sufficient thrust to penetrate the testa.

Further work is needed to establish the role of the testa and endosperm in regulating germination and to determine whether certain environmental factors might influence the hormone levels of embryos and hence act as cues for promoting germination under natural conditions. The sensitivity of seeds to light may change with the age of the seeds, and the length of storage in the dark may also have an effect (Holm & Miller 1972).

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